

Parental behaviour in male and virgin white-toothed shrews *Crocidura russula monacha* (Soricidae, Insectivora)

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Abstract

Both the parental behaviour of male shrews toward their own young as well as virgins to foster young was examined. In the intact family group, ninety percent of the males crouched over young in the family nest (Experiment 1). In the absence of the mother, males only crouched over the young which were in the nest and only one out of five retrieved scattered young (Experiment 2). Thus it appears that the contributions of fathers to the care of young is limited to bodily contact which may be an important source of heat for the young. Virgin shrews did not exhibit spontaneous maternal behaviour and could not be induced to become maternal by exposure to 3 pups for 6 hours daily for 10 days (Experiment 3). The pups were most commonly ignored by virgins although agonistic behaviour was seen in 25 % of the observations.

Introduction

Parental behaviour has been studied in a variety of mammalian species, but only little is known about this behaviour in shrews (Soricidae; Insectivora). Since the insectivores are generally regarded as the remote ancestors of all living eutherian mammals (ROMER 1970) it would seem important to learn more about the behaviour of shrews in comparison with mammals of higher orders.

Descriptive studies of maternal care in shrews include general reproductive behaviour in *Sorex araneus* (CROWCROFT 1957), mutual mouth licking between mother and young in *Suncus murinus* (STINE and DRYDEN 1976) and caravanning in several species of Soricidae-Crocidurinae (GRÜNWARD and MÖHRES 1974). Nursing, caravanning, retrieving and nest-building were studied in lactating white-toothed shrews *Crocidura russula monacha* (*C. r. m.*) by HELLWING (1971a).

In laboratory rats (*Rattus norvegicus*) prolonged exposure to young induces the onset of parental behaviour in males and nulliparous females (ROSENBLATT 1967). In laboratory mice (*Mus musculus*) parental behaviour occurs spontaneously in both sexes (NOIROT 1972). Studies of responsiveness to young in shrews other than the mother are very scanty. CONAWAY (1958) reported that adult non-lactating females of least shrews (*Cryptotis parva*) cared for alien young and that males also showed considerable "maternal behaviour". In a preliminary study on white-toothed shrews, HELLWING (1971a) found that virgins were aggressive towards young while four out of ten males retrieved their offspring when the mothers were removed from the nests.

The purpose of the present study was to learn about paternal participation in raising pups in *Crocidura russula monacha* and to determine whether virgin females of this species show maternal behaviour and, if not, whether it is possible to induce such behaviour by exposing virgin animals to young, as was demonstrated in the rat (ROSENBLATT 1967).

Methods

Animals

Subjects were white-toothed shrews reared in captivity at the Canadian Center of Ecological Zoology of Tel Aviv University. Breeding pairs were housed outdoors on stainless steel cages ($49 \times 34 \times 20$ cm) with bedding consisting of a sand layer covered with wood shavings, and straw provided as nesting material. Throughout the year, the duration of daylight ranged from 10–14 hours, the temperature varied from 8 °C (January) to 30 °C (August) (20 °C annual average) and the mean relative humidity was 70 %. Animals were fed (*ad libitum*) with fly larvae and a mixture of ground meat, hard-boiled eggs and milk powder. For details of the maintenance of the shrew colony see HELLOWING (1971b).

Experiment 1

To examine the interaction between the father and offspring in the intact family unit, the male's location with respect to the young was recorded daily in 23 pairs, from the day of birth until weaning 23 days later. Two clay pots for nesting and shelter were placed side by side at the rear of the cage. Every morning, the clay pots were lifted and the male's location (in the pup's nest or in another nest) was recorded.

Experiment 2

To check whether the presence of the mother influences the interaction between the male and his offspring, the behaviour of 5 fathers was recorded in the absence of their mates. On days 2, 4, 6 and 8 postpartum, each male was left alone in the cage following removal of the mother and young. Thirty minutes later, 3 of the offspring were placed in the middle of the cage in a small depression in the sand 20 cm away from the nest site. Observations were recorded for 15 minutes after presentation of young and 3 spot checks of the location of the male and young were made at one hour intervals. At the end of the 3 hour observation period, the mother was returned to the family cage.

Experiment 3

In this experiment, the response to young in nulliparous female shrews was tested. Fifteen sexually mature virgins were housed individually in glass cages ($46 \times 23 \times 30$ cm) wrapped with red paper (to reduce the amount of light entering the cage) and provided with paper strips (12×1.2 cm) as nesting material. After 2–3 days of habituation to the cage, each virgin was exposed to 3 pups (2–8 days old), for 6 hours daily, for 10 days. The young were placed in a depression in the middle of the cage and the female's behaviour was recorded (on a standard observation sheet) for 15 minutes followed by hourly spot checks for 6 hours. When a pup was detected bitten or killed, the remainder were removed from the cage and on the next day the female was exposed to a single pup (usually 6–8 days old). If this pup was unharmed, the female again received the standard litter of 3 pups in the following tests. The pups were provided by donor mothers and returned to them at the end of the 6-hour test-period.

Results

Experiment 1

All 23 males were observed to maintain body contact with young in the family nest. The daily percentage of males found in the nest with the young ranged between 80 % to 100 % throughout the 23 days postpartum. However, males were never seen to exhibit more active components of parental behaviour, e.g. retrieving, caravanning or nest-building.

Experiment 2

Even in the absence of their mates, males did not retrieve young to the nest site, excepting on a single occasion. Pups aged 6–8 days crawled to the nest by themselves and crouching behaviour occurred in 75 % of 28 cases in which young were present in the nests. Males never crouched over young in the sand depression outside the nest. Only on one occasion was a male observed to crouch over younger pups.

Experiment 3

During the 10 days of tests, most of the 15 virgins ignored the pups on most tests. Complete maternal behaviour (crouching, retrieving or caravanning, nest building, anogenital licking) did not occur spontaneously on the first daily test nor did it develop as a result of daily exposure to pups. Only 5 females crouched over pups during some spot checks (11 % of mean of daily sample means).

Discussion

In some mammalian species, males are prone to killing young, and females usually prevent them from having access to their offspring. In many species of rodents males show caretaking behaviour which includes nest-building, defence of home range and nest, retrieving, licking of young and crouching over young (SPENCER-BOOTH 1970). The present study shows that male white-toothed shrews do not normally kill young, and the females, who tolerate the males' presence in the nest, permit them to maintain body contact with the offspring. Of the repertoire of parental activities, male white-toothed shrews almost exclusively exhibited crouching over young. The absence of other components of parental care cannot be attributed to suppression by the females since even in their absence the males' parental repertoire consisted solely of crouching.

Shrews are among the smallest of mammals and their energetic requirements for maintaining homeothermy are extremely high. Conservation of body heat of the young may be of primary importance for their successful development, and this would lend great ecological and physiological significance to the males' crouching behaviour over the young. In addition, since shrews spend much of their time obtaining food, such parental behaviour may permit lactating mothers to spend less time in the nest and more time foraging. In fact, males were frequently observed to crouch in the family nest while the females were feeding in the food dish.

Virgin shrews failed to show maternal behaviour either spontaneously or by induction during 10 days of exposure to pups (Experiment 3). These females did not kill pups, rather they usually ignored them. This pattern differed from the behaviour observed in virgin females of domesticated rodent species in which most animals show maternal behaviour spontaneously (laboratory *Mus musculus* and some *Rattus norvegicus* strains, JAKUBOWSKI 1979), or after continuous exposure to pups (golden hamsters *Mesocricetus auratus*, SWANSON and CAMPBELL 1979; rats *Rattus norvegicus*, ROSENBLATT 1967). However, naive virgin wild *Mus musculus* show no spontaneous maternal behaviour, nor can they be induced to become maternal by exposure to young (JAKUBOWSKI 1979). We speculate that spontaneous maternal behaviour may be an artifact of domestication which does not ordinarily occur in wild members of a mammalian species; consequently virgin shrews showed no spontaneous maternal behaviour, although the shrew breeding colony exists for about 15 years at the research zoo at Tel Aviv University.

Zusammenfassung

Elterliches Verhalten von Männchen und Jungweibchen bei der Spitzmaus Crocidura russula monacha (Soricidae, Insectivora)

Die Bereitschaft zur Jungenfürsorge wurde bei Vätern und jungen Weibchen der Hausspitzmaus (*Crocidura russula monacha*) geprüft. Der Beitrag der Väter beschränkte sich auf anhaltenden Körperkontakt, dessen Bedeutung für die Jungenentwicklung diskutiert wird. Weder unerfahrene Jungweibchen noch solche, die bereits zehn Tage lang mit Jungtieren zusammen waren, zeigten mütterliche Verhaltensweisen. Gewöhnlich kümmerten sie sich nicht um die Jungen.

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Der Einfluß visueller Information auf die Echoortung bei *Phyllostomus discolor* (Chiroptera)

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Abstract

The influence of visual information on echolocation in Phyllostomus discolor (Chiroptera)

Investigated was the obstacle avoidance performance in a flight tunnel of the neotropical bat *Phyllostomus discolor*. The orientation sounds resemble the typical phyllostomatid type (duration: 0.3 to 2.5 ms; 3 downwards modulated harmonics, which cover the frequency range from ca. 45–100 kHz). In flight the intensity of the sounds reaches 124 dB (calculated to a distance of 10 cm in front of the nose); when approaching the landing site the intensity falls to ca. 75 dB.

Wires down to a diameter of 0.25 mm can be detected acoustically; this threshold value is not improved by visual information. In the above-threshold-range the repetition rate in front of the obstacle is significantly lower, when the wires can be localized visually. In this situation body contacts with the obstacle are much reduced compared with flights in the dark tunnel.